

Make Based Flow Engineering

A Customizable Flow Generator

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Outline

Make Based
Flow
Engineering

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Introduction

Make

What is "make"
In the context of
flow

Showcase

Cadence low
power flow
(frontend)
"Mickey-Mouse"
flow generator

Summary

1 Flows Are Complicated

2 Make

- What is "make"
- In the context of flow

3 Showcase

- Cadence low power flow (frontend)
- "Mickey-Mouse" flow generator

4 Summary

Flows Are Complicated

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Summary

- Complex Procedure
- Multiple Tools
 - Cadence tools, Synopsys tools, etc.
 - Tool versions
 - "All tools suck".
—Steve Golson & Pete Churchill
- Different Technologies
- Different Platform
 - Path difference, shell difference, etc.

What Is Make

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Summary

- A tool widely used in software compilation
 - Dependency analyzer; history tracker
 - "Makefile" as the headquarter

Makefile Syntax

```
$(target): $(objects)  
    command1  
    command2
```

Example: compile f1.out from f2.o and f3.o that are dependent on f4.c and f5.c with compiler gcc.

```
f1.out:f2.o f3.o  
    gcc -o f1.out f2.o f3.o  
f2.o:f4.c  
    gcc -c f4.c -o f2.o  
f3.o:f5.c  
    gcc -c f5.c -o f3.o
```

- Procedure centric VS dependency centric

In the Context of Flow

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How does “make” fit into flow engineering

- Flow scripts have dependencies
 - e.g. the backend needs netlist generated from the frontend.
- Flow needs to invoke different tools in a proper order
- “Make” can figure out the sequence of invoking different tools based on their dependencies

What Makes A Flow Generator

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Summary

- A makefile generator
- An abundant script library (plugins)
 - Users can pick the functionalities they want to make a customized flow
- A user interface (CLI/GUI)
 - More user friendly than pure scripts
 - Future placeholders (e.g., interactive debugging)

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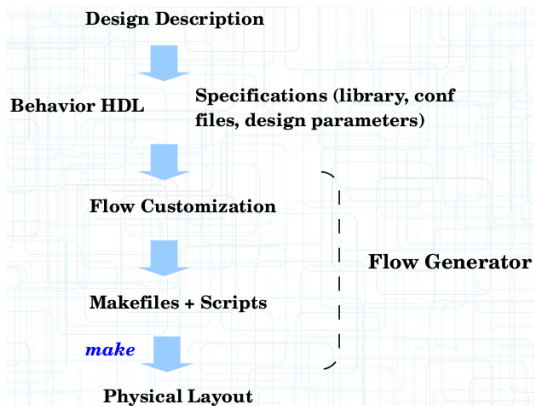
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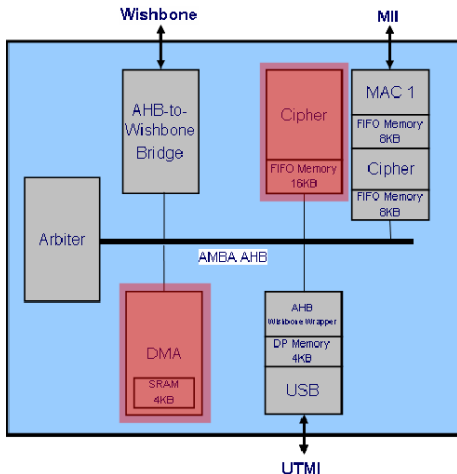
Summary



Cadence Low Power Flow(Frontend)

How "make" automates a flow

- IBM-Chartered 90nm CMS9FLP Process
- Multi-Vt, multiple voltage islands, DFT



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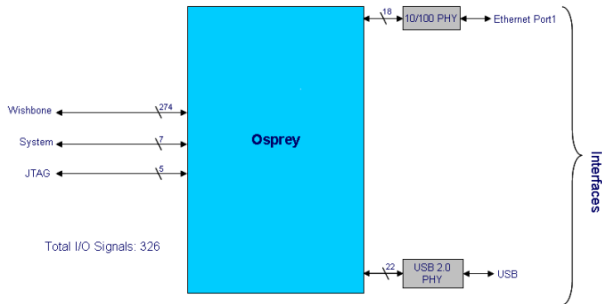
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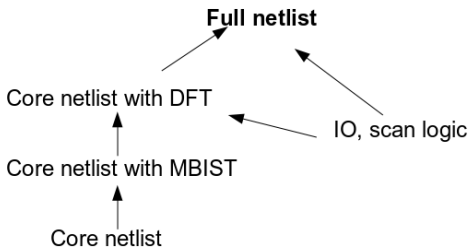
Summary



Cadence Low Power Flow(Frontend)

How “make” automates a flow

- Dependency tree analysis



- Writing init.sh that generates makefile
- Invoking “make” with “--keep-going” (ignore Cadence warnings)
- Taking more than 10 hours on hazeltop

Cadence Low Power Flow(Frontend)

How “make” automates a flow

Makefile screenshot

Final Target

```
/home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists/osprey_elab_toplevel.v /  
home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists/  
osprey_g2c_toplevel_n0levelshifters.v /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/  
synth/netlists/osprey_g2c_toplevel_levelshifters.v: /home/ll2bf/scratch/source/  
CommonPlatform_90LP_v1.0/synth/netlists/osprey_toplevel_noshifter.v  
    cd /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/synth && ./  
run_RC_toplevel osprey  
  
/home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists/  
osprey_toplevel_noshifter.v: /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/  
topshell/testresults/designsource/osprey.v /home/ll2bf/scratch/source/  
CommonPlatform_90LP_v1.0/synth/netlists/osprey_Core_g2c_dft_postmbist_nolevel.v  
    cd /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists && ./  
create_full_netlist  
  
/home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/mbist/testresults/designsource/  
osprey_Core_tem.v /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/topshell/  
testresults/testmode_data/osprey.bsd: /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/  
synth/netlists/osprey_Core_g2c.v  
    cd /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/mbist && ./  
insert_embedded_test.tcl  
  
/home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists/  
osprey_Core_elab_dft_postmbist.v /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/  
netlists/osprey_Core_g2c_dft_postmbist_nolevel.v: /home/ll2bf/scratch/source/  
CommonPlatform_90LP_v1.0/FRONTEND/mbist/testresults/designsource/osprey_Core_tem.v  
    cd /home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/FRONTEND/synth && ./  
run_RC_post osprey  
  
/home/ll2bf/scratch/source/CommonPlatform_90LP_v1.0/synth/netlists/osprey_Core_elab.v /home/
```

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“Mickey-Mouse” Flow Generator

A minimalist flow generator

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■ Source file structure

- `./init.sh`: an interactive bash script
- `./params.cfg`: a configure file containing flow parameters
- `./src`: directory for script library, frontend input, backend input and other utilities
- `./exe`: directory for customized flow scripts generated by users
- `./dump`: directory for results

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A minimalist flow

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■ Flow

- Set up Cadence environment, and copy HDL source to `./src/hdl`
- Start with script “init.sh”, and specify language type

```
[ll2bf@ivycreek inst]$ sh init.sh
```

```
$FLOWROOT is set to be /var/home/ll2bf/projects/flow/inst, which you can utilize  
in this setup.
```

```
*****
```

```
Welcome to Flow Generator v1.2
```

```
If you have any comment please email lijun@virginia.edu
```

```
Please check out /var/home/ll2bf/projects/flow/inst/readme for more details about  
this program
```

```
Now reading HDL codes in /var/home/ll2bf/projects/flow/inst/src/hdl...
```

```
What is the language of HDL file(s)? [1]Verilog; [2]VHDL:
```

```
1
```

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Summary

■ Flow (Cont'd)

■ Specify toplevel module defined in HDL source

Now reading HDL codes in /var/home/ll2bf/projects/flow/inst/src/hdl...

What is the language of HDL file(s)? [1]Verilog; [2]VHDL:

1

Find 1 Verilog files

Define \$toplevel, followed by [Enter]:

accu

■ Specify the path of backend input files

Now set up the input path...

[1]: Auto config (files already in ROOT/src/lib); [2]: Manual config

Type your option, followed by [Enter]:

1

■ Customized scripts (including makefile) generated

Read path from /var/home/ll2bf/projects/flow/inst/src/lib

Files generated:

/var/home/ll2bf/projects/flow/inst/exe/rtl.tcl

/var/home/ll2bf/projects/flow/inst/exe/flow.cfg

/var/home/ll2bf/projects/flow/inst/exe/toplevel.tcl

/var/home/ll2bf/projects/flow/inst/exe/makefile

Do you want to run the flow now? (y/n):

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- The idea of automating flow with “make”
- Demo
 - The power of “make” in a complex flow
 - The interface of a minimalist flow generator
- From this project...
 - The idea of “make”
 - Subtleties and complexities in circuit design